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AUTHOR(S):

HAGIWARA, Hachiro

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The spatial distribution of cities, landscape change and traditional agriculture in the Tokushima region

Hagiwara Hachiro

Faculty of Management and Information Science, Shikoku University

Abstract

Tokushima Prefecture is located on the eastern side of Shikoku Island, and 80% of its area is mountainous with 75% of the soil surface covered with trees. In the 1950's period, the local population in such rural mountainous areas reached its peak. In Tokushima and across Japan, people needed to develop agricultural fields even on the steep slopes, and tried to grow rice by making terraced paddy fields, by piling stones vertically. Since the Rapid Economic Growth period, which began in the middle of 1950's, people started to leave their home villages and move to urban areas for work. When they left their agricultural fields, they planted cedar trees, because cedar wood was sold at a high price at that time. Decades later, however, the cedar lumber price dropped due to the increase in the importation of cheaper woods. Abandoned cedar trees continued to grow covering the former agricultural fields.

Today, many villages in mountainous areas of Tokushima are at risk of extinction due to the falling population and aging (*genkai shūroku*). Many agricultural fields are left abandoned. In the context of re-vitalization of the diminishing rural communities, traditional landscape is being reappraised as a local treasure. Consequently, the UN Food and Agriculture Organization (FAO) founded the World Agricultural Heritage Systems in 2002, and 45 regions in 19 countries were registered by the end of 2017, of which 9 regions are located in Japan. The traditional farming systems on the steep slopes in mountainous areas of Tokushima are among the candidates for registration. The top 100 Terraced Paddy Fields in Japan were selected by the Ministry of Agriculture, Forestry and Fisheries in 1999, and two of them are located in Tokushima Prefecture.

Stone walls (*ishigaki*), built to make flat land on a steep slope, are constructions that use a traditional type of architectural technique, and recently it has been reappraised from an ecological viewpoint in comparison with contemporary concrete constructions. Generally, the earths and soil slide down the steep slopes due to gravity, so it is necessary to bring these back upward from time to time. On the steep slopes people try to keep earth and soil in its present position by mixing thatch with earth and soil. If local people abandon their agricultural activities and discontinue the maintenance works, this kind of traditional landscape on the steep slopes will deteriorate soon. The speaker will discuss about steep slope agricultural systems, terraced paddy fields (*tanada*), and a village rich in stone walls in Tokushima.

Keywords: The Urban system of Tokushima prefecture, Tanada (terraced paddy fields), Ishigaki or Ishizumi (stone walls, masonry), Kyukeishachi-nouhou (agricultural system on steep slopes), and Kyoudou (collaboration, working together with others)

1. Introduction

Tokushima Prefecture is located on the eastern side of Shikoku Island, and 80% of its area is mountainous with 75% of the soil surface covered with trees. In the 1950s, the local population in such rural mountainous areas reached its peak. In densely populated rural mountainous areas, people needed to develop agricultural fields even on the steep slopes, and tried to grow rice by making terraced paddy fields (*tanada*), by piling stones vertically.

Since the Rapid Economic Growth period, which began in the middle of the 1950s, people started to leave their home villages in rural areas

and move to urban areas in search of work. When they left their agricultural fields, they planted cedar trees, because cedar wood was sold at a high price at that time. Decades later, however, the cedar lumber price dropped due to the increase in the importation of cheaper timber.

Today, cutting down a cedar tree results in 1,000 yen deficit. So, abandoned cedar trees continue to grow, covering the former agricultural fields.

2. Spatial distribution of cities in Tokushima Prefecture



Figure 1: Geomorphology of Shikoku Island
出典)国土交通省四国地方整備局

This satellite image shows the geomorphology, or land features, of Shikoku Island.

Geological layers run in an east to west direction in the northern part of Shikoku.



Figure 2: Landsat image of Shikoku Island taken from an east to west direction.

The Yoshino River forms an important alluvial plain in the island and Tokushima City is located around the mouth of the Yoshino River.

Curiously, it is possible to perceive some similarities between Brazil and Tokushima prefecture.

The first point is the shape of Brazil and Tokushima Prefecture. And the second similarity is that a big river runs in the north, from west to east.

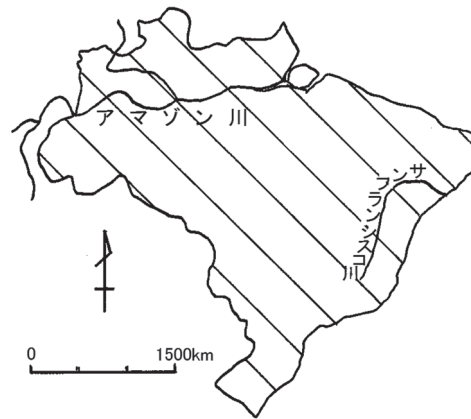


Figure 3: Brazil

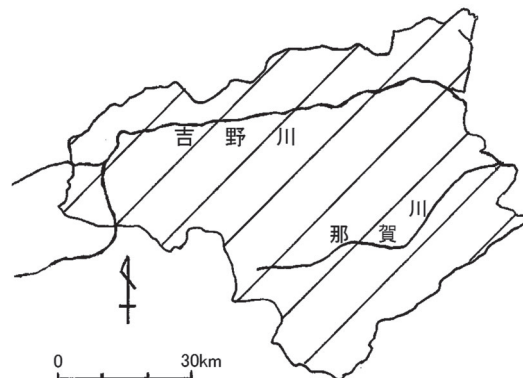


Figure 4: Tokushima Prefecture

The Amazon River runs in the north of the country, from west to east. And the Yoshino River runs in the north of Tokushima Prefecture, from west to east.

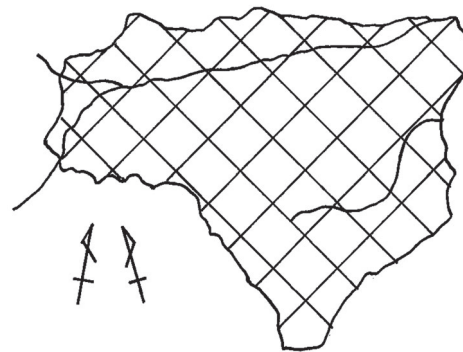


Figure 5: Combined shape of Brazil and Tokushima Prefecture

If we combine the two areas on top of each other, this is the shape that would come out. Another interesting fact is that São Paulo State and Tokushima Prefecture have been friendship partners since 1984, and the shape of São Paulo State and Tokushima Prefecture are also similar.

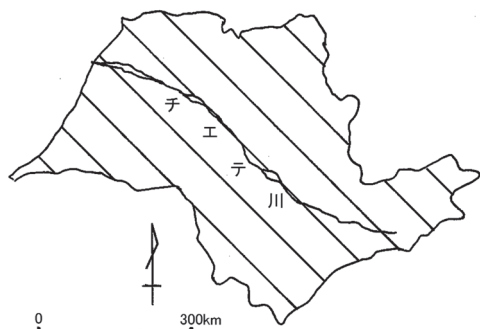


Figure 6: São Paulo State

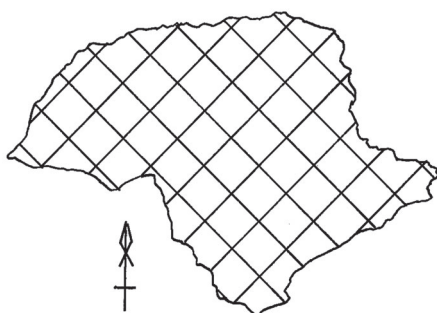


Figure 7: Combined shape of São Paulo State and Tokushima Prefecture

Figure 6 shows São Paulo State and the Tietê River that runs from east to west. If we combine the two areas on top of each other, it is possible to see the shape of figure 7.

Table 1: Changes in Population of Tokushima Prefecture, Tokushima City and Kamikatsu Town in about 100 years.

year	Tokushima Prefecture	Tokushima City	Kamikatsu Town
1920	670,212	68,457	5,172
1925	689,814	74,545	5,298
1930	716,544	90,454	5,139
1935	728,748	97,022	5,180
1940	718,717	119,581	5,276
1947	854,811	102,672	6,005
1950	878,511	121,416	6,356
1955	878,109	171,419	6,265
1960	847,274	182,782	5,915
1965	815,115	193,233	5,003
1970	791,111	223,451	4,057
1975	805,166	239,281	3,587
1980	825,261	249,343	2,918
1985	834,889	257,884	2,712
1990	831,598	263,356	2,450
1995	832,427	268,706	2,318
2000	824,108	268,218	2,124
2005	809,950	267,833	1,955
2010	785,491	264,548	1,783
2015	755,733	258,554	1,545

This table shows changes in population of Tokushima Prefecture, Tokushima City (capital city) and Kamikatsu Town (rural villages' area) in about 100 years. Kamikatsu received the category of town when its population reached more than 5,000 people. The peak of the population of Tokushima Prefecture and Kamikatsu Town was in 1950. And the peak of the population of Tokushima City came later, in 1995.

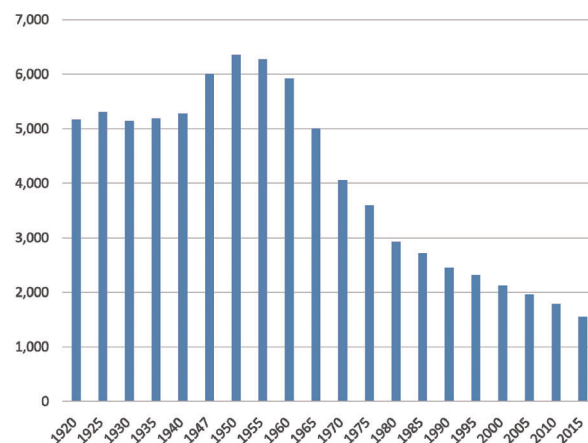


Figure 8: Population changes of Kamikatsu Town

Figure 8 shows population changes of Kamikatsu Town. The peak of the population of Kamikatsu Town came 5 years after the end of WWII.

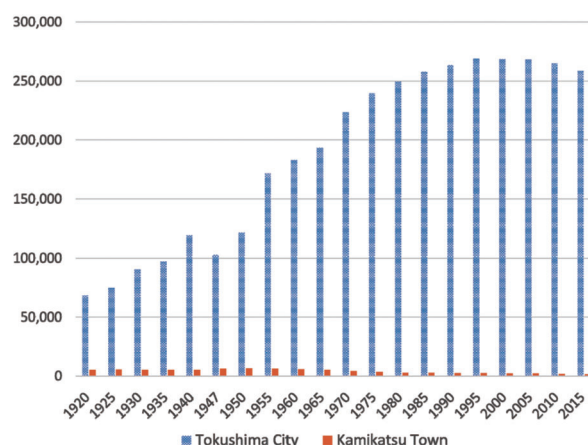


Figure 9: Population changes of Tokushima City.

Figure 9 shows population changes of Tokushima City. The population of Tokushima City continued to grow until 1995, and it started to decrease.

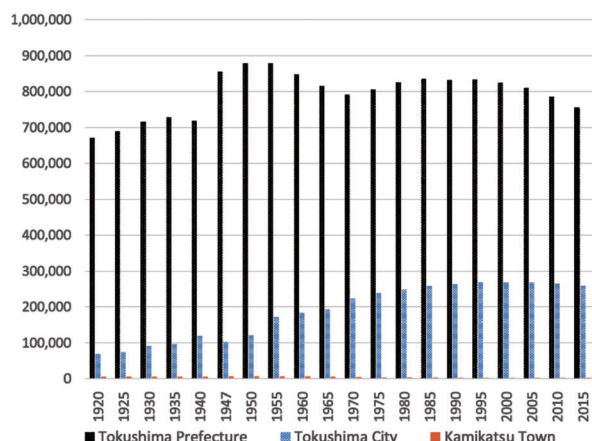


Figure 10: Population changes of Tokushima prefecture, Tokushima City and Kamikatsu Town

Figure 10 shows population changes of Tokushima prefecture, Tokushima City and Kamikatsu Town. The population of Tokushima Prefecture started to decrease once in 1950, and started to decrease again in 1995.

Table 2: Basic numbers of the four prefectures of the Shikoku Region

	Ehime Pref.	Kagawa Pref.
Area	5,676km ²	1,877km ²
population	1,400,000	980,000
Capital	Matsuyama (520,000)	Takamatsu (420,000)
	Kochi Pref.	Tokushima Pref.
Area	7,115km ²	4,147km ²
population	740,000	760,000
Capital	Kochi (340,000)	Tokushima (260,000)

Total Area of Shikoku : 18,804km² population : 3,880,000

* Data: April 2015

Table 2 shows that Kochi is the largest and Kagawa is the smallest prefecture in area, and Ehime is the biggest and Kochi is the least prefecture in population of the Shikoku Region. This table also shows that Matsuyama is the largest and Tokushima is the smallest capital city in terms of population in the Shikoku Region.

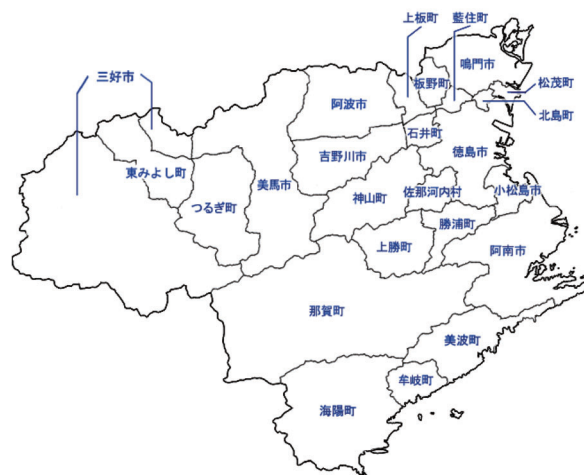


Figure 11: Administrative division of Tokushima Prefecture

Tokushima Prefecture is composed of 8 cities, 15 towns and 1 village, totaling 24 municipalities.

Table 3: Ranking of the cities and towns of Tokushima Prefecture, according to population size and population density.

	自治体	Administrative Division	Population	Area(km ²)	Density (人/km ²)
	徳島県	Tokushima Prefecture	755,733	4,146.80	179.26
1	徳島市	Tokushima City	258,554	191.39	1,345.75
2	阿南市	Anan City	73,019	279.25	256.63
3	鳴門市	Naruto City	59,101	135.66	425.01
4	吉野川市	Yoshinogawa City	41,466	144.14	280.08
5	小松島市	Komatsushima City	38,755	45.37	830.44
6	阿波市	Awa City	37,202	191.11	189.65
7	藍住町	Aizumi Town	34,626	16.27	2,150.65
8	美馬市	Mima City	30,501	367.14	80.44
9	三好市	Miyoshi City	26,836	721.42	35.42
10	石井町	Ishii Town	25,590	28.85	878.93
11	北島町	Kitajima Town	22,446	8.74	2,580.66
12	松茂町	Matsushige Town	15,204	14.24	1,052.53

(Census 2015)

Table 3 shows the ranking of cities and towns of Tokushima Prefecture, according to population size and population density. The 5 biggest cities in population size are Tokushima City, Anan City, Naruto City, Yoshinogawa City, and Komatsushima City. The 5 top cities and towns in population density are Kitajima Town, Aizumi Town, Tokushima City, Matsushige Town, and Komatsushima City. These top cities and towns in population size and density are located in a T-shaped area that concentrates the population of Tokushima Prefecture.



Figure 12: T-shaped population concentration area of Tokushima Prefecture.

The main cities of Tokushima prefecture are located along the coast line and the Yoshino River, where the land is flat or less inclined. They form the T-shaped population concentration area of Tokushima Prefecture.

It is said that not only the physical geomorphology but also historically developed human interactions and interests are facing to the east direction, which is the direction where the large cities of the Kansai Region are located. Tokushima, in comparison with other prefectures of Shikoku, has the strongest socio-economic connection with the Kansai Region. Taking into consideration the geographical features of population distribution and the formation of the urban system in Shikoku, it is worth now to look at some specific case studies of the types of traditional agricultural landscapes and their transformation.

3.Traditional agricultural landscapes and their change



Figure 13: Tikagawa, Kitou, Naka Town

The first case study is a yuzu citrus farm on a steep slope in the Kikagawa area, Kitou district, Naka Town.



Figure 14: Yuzu citrus and its farm on a steep slope in Tikagawa

This image shows a terraced yuzu citrus farm on a steep slope. The yuzu trees are planted in narrow flat belts on terraces of steep slopes. Yuzu trees are planted on flat land, so that the harvest work becomes easier using special length adjustable cutting tools. The Kitou area is known for its yuzu production of excellent quality. Effort to add even more value to the Kitou brand has been encouraged in recent years and the export of Kitou yuzu to Europe has started.



Figure 15: Nishiiya, Miyoshi City

The second case is a potato farm field in Nishiiya district, Miyoshi City. Miyoshi City was founded in 2006, by incorporating 4 towns and 2 villages, in order to become a city with a larger area. But the total population is less than 30,000, and the population density is very low. How is this area changing?



Figure 16: Potato field and stone walls in Nishiiya

Nishiiya is an area where the population occupied flat lands inside a mountainous region. Flat lands can be found even in high lands, and stone walls are very high in some places. Figure 16 shows the students of Shikoku University and employees of Livedo Corporation, an adult diaper manufacturer, who are working together in a potato field in the scheme called Tokushima Owen Shitai (Let us support Tokushima). But after the last collaboration which was in July 2017, the people of the local community have decided not to ask for others' support anymore, and to continue just by themselves as long as possible.



Figure 17: Shimokage, Ikawa, Miyoshi City

The third case study are terraced paddy fields in Shimokage, Ikawa, Miyoshi City.

The Japanese Ministry of Agriculture, Forestry and Fisheries selected the top 100 Terraced Paddy Fields in Japan in 1999, and two of them are located in Tokushima Prefecture. One of them is Shimokage located in the Tokushima Prefecture. When Shimokage was recognized as one of the top 100 stepped paddy fields of Japan in 1999, its paddy fields were kept in good condition.



Figure 17: Partly deteriorated paddy fields and electric fence in Shimokage

Figure 17 shows that some paddy fields on the right side have deteriorated and an electric fence was erected to keep unwanted animals such as wild

boars, deers and monkeys away. Electric shock, is especially effective against monkeys which can clear the fence easily.



Figure 18: The certification plate as one of the top 100 stepped paddy fields of Japan and old stone walls in Shimokage

Figure 18 shows the certification plate that Shimokage was selected as one of the top 100 stepped paddy fields of Japan in 1999. The certification plate is placed against old stone walls which are remains of former stepped paddy fields. Farmers planted cedar trees, when they left the land several decades ago the former paddy fields left behind have deteriorated and the landscape of the area has greatly changed after the cedar trees grew.



Figure 19: Hoichi, Higashimiyoshi Town

The fourth case study is a vegetable farm field in the Hoichi area, Higashimiyoshi Town.

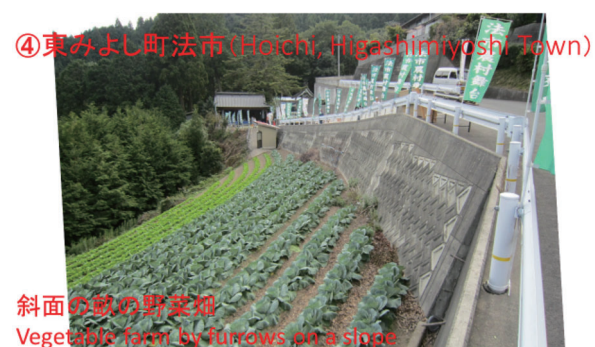


Figure 20: Vegetable farm by furrows on a slope in Hoichi

Figure 20 shows that vegetables are planted in lines of furrows on a slope. The earth and soil slide down the steep slopes due to gravity, so it is necessary to bring these back upward from time to time. If local people abandon their agricultural activities and discontinue maintenance work, this kind of traditional landscape on the steep slopes will deteriorate fastly.

⑤吉野川市美郷大神 (Oogami, Misato, Yoshinogawa City)



Figure 21: Oogami, Misato, Yoshinogawa City

The fifth area is Oogami, Misato, Yoshinogawa City. This area is known as Takagai Masonry village. This area is located on high lands and on very steep slopes, so this landscape reminds us of Machupichu in Peru.

⑤高関の石積み地区 (Masonry village of Takagai)



Figure 22: Masonry village of Takagai in Oogami

Stone walls were built very high in order to get very limited flat belts in Oogami. The masonry village of Takagai is well known today thanks to its excellent landscape. So, residents prefer planting moss phlox widely, which flourish in spring and attract visitors.

⑥上勝町榎原 (Kashihara, Kamikatsu Town)



Figure 23: Kashihara, Kamikatsu Town

The sixth area are terraced paddy fields in Kashihara, Kamikatsu Town. Kashihara is one of the two of the Top 100 Terraced Paddy Fields in Japan which are located in Tokushima.

⑥上勝町榎原の棚田地区 (Kashihara, Kamikatsu Town)



地滑り防止用の集水井工の縦穴 (pit of a drainage well to prevent landslides)

Figure 24: Pit of a drainage well to prevent landslides in Kashihara

Figure 24 shows a pit of a drainage well to prevent landslides in the Kashihara terraced paddy fields area. After this drainage well was constructed, landslides occur with much less frequency than before.

⑥上勝町榎原 (Kashihara, Kamikatsu Town)



粘性の高い土で水田の縁を盛り上げる作業 (Mounding edge of paddy field with viscous soil)

Figure 25: Piling stones and mounding edge of paddy fields with viscous soil

Figure 25 shows men piling stones and mounding edge of a terraced paddy field with viscous soil.



Figure 26: Irodoriyama, Kamikatsu Town

The seventh area is Irodoriyama, Kamikatsu Town. Irodoriyama used to be a cedar forest on abandoned terraced fields, but this place started to be developed with agroforestry since 2017.



Figure 27: Cedar trees and *Hawasabi* (Leaf wasabi) planted on former terraced paddy fields

Figure 27 shows cedar trees which were planted near the edge of terraces in order to open the pathway on the flat belt of terraces. Some cedar trees were cut down in order to provide space for cultivating different plants. Here, *Hawasabi* (leaf wasabi) was planted between cedar trees. This is a kind of agroforestry. Leaves of the wasabi plant are edible, and they taste like wasabi. Hamburgers with wasabi leaves are very tasty and the local producers believe that there is a potential market for the production of leaf wasabi.

These cases studies are included in the project Tokushima *Furusato Ouen Shitai*, which emphasizes *kyoudou* (collaboration, the act of working together with others). The expression *Ouen Shitai* has a double meaning that expresses the desire to support someone and the creation of a supporting unit or detachment workforce unit. In this scheme, local leaders of rural areas ask for help and other social sectors as companies, educational institutions, pro-

fessional sports teams etc. offer their labor forces. The prefectural government intermediate in the process of matching up the different sectors. Apart from the case studies of agriculture on steep slopes supported by the project *Tokushima Furusato Ouen Shitai*, it is also worth to mention other types of projects of revitalization of traditional agricultural practices, which are considered to be a local heritage. This is the case of Nishi-Awa

4. Steep slope land agriculture system in Nishi-Awa

The “Nishi-Awa” Region is located in western Tokushima Prefecture. In the mountainous region of Nishi-Awa, depending on the location, the land sits at an inclined slope as steep as 40 degrees. Within that, the farm work takes place not on a flat field, but on the inclined superficie of the slope as they have been originally shaped. Slopes are excessively steep to make terraced flat belts. On the steep slopes people try to keep earth and soil in its present position by mixing cut hay with earth and soil. The runoff of soil from these steep inclines due to wind and rain are controlled as the fields are covered with cut hay.

Yearly production of an assortment of *soba* (buckwheat) and other grains, edible wild plants, vegetables, fruits, and other types of crops have been produced and amassed with a farming system suitable for this type of mountainous environment. Through over 400 years, this farming system has been passed down to several generations of local farmers and, as a result of this human-natural management of landscapes, various plants and animals have had the opportunity to thrive. This type of mountainous agricultural practice include the Slash-and-Burn farming method which encompasses a deep sense of Japanese nostalgia. The traditional food culture of preserve fruit and vegetables (pickle), the annual promotion of traditional events, and the vast nature of the region have all been maintained by very hands of people in close relationship with the natural environment of the region.

As a result of this long-term socio-natural interactive process, Tokushima Tsurugisan Council for the Promotion of World Agricultural Heritage Systems was founded in 2014 by the four related local governments in the Nishi-Awa Region. Moreover, on March 9th of 2018, the Steep Slope Agriculture System in Nishi-Awa was registered as one of the World Agricultural Heritage Systems by the Food and Agricultural International Organization (FAO).

5. Conclusion

This paper has mentioned the several types of local agricultural techniques developed in Tokushima Prefecture: steep slope agricultural systems (*Kyukeishachi-nouhou*), terraced paddy fields (*tanada*), and villages rich in stone walls in mountainous areas. Along the history, people were obliged to develop agricultural fields even on steep slopes of densely populated rural areas, developing these particular types of local agricultural techniques that counted with the support of specific architectural techniques. Stone walls (*ishigaki*) and masonry (*ishizumi*), built to make flat land on a steep slope, are constructions that use a traditional type of architectural technique, and they have been recently reappraised from an ecological viewpoint in comparison with contemporary concrete constructions, especially after a series of natural disasters occurred in Japan. If local people abandon their agricultural activities and discontinue the maintenance work of stone walls, this kind of traditional landscape on steep slopes will not be maintained as it is in its present condition. The reassessment of the long term processes that supported the shaping of these landscapes, and the collaborative work and exchange with people from different sectors (*kyoudou*) has the potential to make rural communities more active and allow for the maintenance of these landscapes for a longer time.

References

- 1) Tokushima Tsurugisan Council for the Promotion of World Agricultural Heritage Systems, "Nishi-Awa's farming system on the slopes" (<http://giahs-tokushima.jp/steepslopeagriculture>)